Spreadsheets

You will learn about the purpose and strengths of spreadsheets as well as getting an introduction into problem solving and design. Finally visualization techniques will be used to show how information can be effectively represented.

Main Topics To Be Covered

1. History and purpose of the spreadsheet
2. Technical details: Features and benefits of electronic spreadsheets
3. Spreadsheet design
4. Introduction to problem solving using spreadsheets
5. Rules of thumb for the effective presentation of information: Applied principles of Information Visualization

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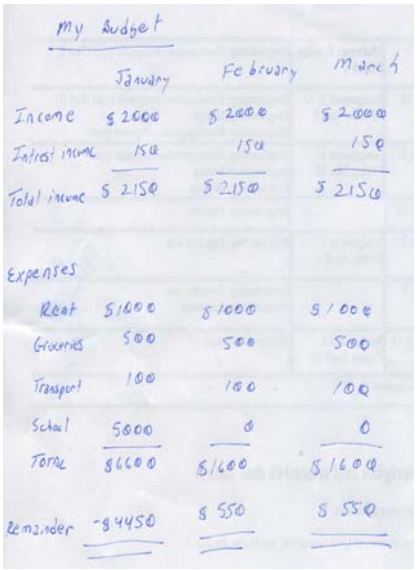
Performing Calculations



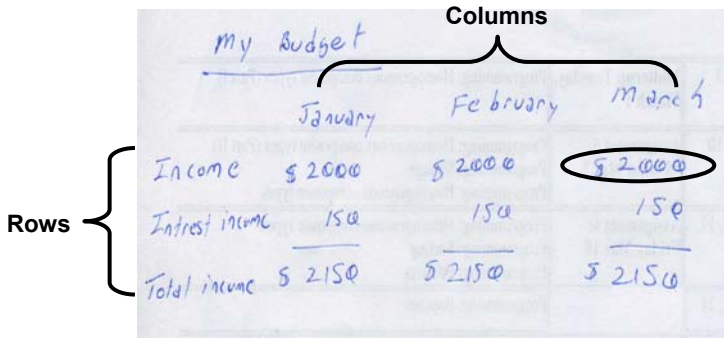
My Budget

	January	February	March
Income	$2000	$2000	$2000
Interest income	150	150	150
Total income	$2150	$2150	$2150
Expenses			
Rent	$1000	$1000	$1000
Groceries	500	500	500
Transport	100	100	100
School	5000	0	0
Total	$6600	$1600	$1600
Remainder	-$4450	$550	$550

Tables

- When performing calculations with different instances of the same data repeated along the rows and columns
- These tables are referred to spreadsheets

Spreadsheet Terminology



Paper Spreadsheets

- The original purpose was to show the data to be used in calculations.
- However making changes could be awkward:
  - Modifying the data e.g., correcting errors
  - Attempting variations e.g., for a personal budget what would be the effect of living in a 1 bedroom vs. 2 bedroom apartment, taking a full time vs. part time job, going on a vacation to Hawaii vs. going to Vulcan Alberta.

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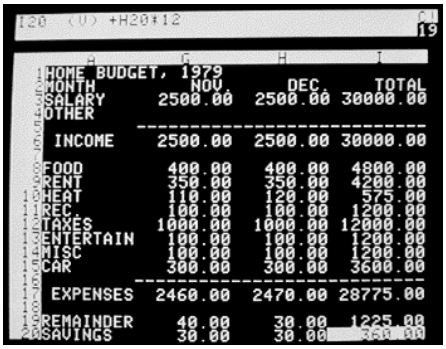
Electronic Spreadsheets



	G	H	I
HOME BUDGET, 1979			
MONTH	NOV.	DEC.	TOTAL
SALARY	2500.00	2500.00	30000.00
OTHER			
INCOME	2500.00	2500.00	30000.00
FOOD	400.00	400.00	4800.00
RENT	350.00	350.00	4200.00
HEAT	110.00	120.00	575.00
REC.	100.00	100.00	1200.00
TAXES	1000.00	1000.00	12000.00
ENTERTAIN	100.00	100.00	1200.00
MISC	100.00	100.00	1200.00
CAR	300.00	300.00	3600.00
EXPENSES	2460.00	2470.00	28775.00
REMAINDER	40.00	30.00	1225.00
SAVINGS	30.00	30.00	960.00

VISICALC Dan Bricklin & Bob Frankston

•Early versions of electronic spreadsheets were primitive but they did what paper spreadsheets did and more.

Some Benefits Of Electronic Spreadsheets

•Calculations can be automated

- Many formulas automatically come with the software e.g., sum a range of numbers along a column **sum(r1:r10)**
- Most any arbitrary formula can be specified by the person creating a particular sheet
  - •E.g., term GPA = (assignment GPA) * (percentage worth for assignment)
  - • + (midterm GPA) * (percentage worth for exam)
  - • + (final exam GPA) * (percentage worth for exam)
- Changes can be quickly made.

	A	B	C
1	Net income	$2,000.00	
2			
3		**Feb expenses**	**March expenses**
4	Rent	$907.00	$907.00
5	Parking	$25.00	$25.00
6	Groceries	$300.00	$300.00
7	Car	$500.00	$500.00
8	Fun	$0.00	$100.00
9	Misc	$100.00	$200.00
10	Total expenses	$1,832.00	$2,032.00
11			
12	Income after bills	$168.00	-$32.00

Row 10 sums all the expenses

The difference between B1 and Row 10

Some Benefits Of Electronic Spreadsheets (2)

- Changes can be quickly made. Some Benefits Of Electronic Spreadsheets

	A	B	C
1	Net income	$2,200.00	
2			
3		**Feb expenses**	**March expenses**
4	Rent	$907.00	$907.00
5	Parking	$25.00	$25.00
6	Groceries	$300.00	$300.00
7	Car	$500.00	$500.00
8	Fun	$0.00	$100.00
9	Misc	$100.00	$200.00
10	Total expenses	$1,832.00	$2,032.00
11			
12	Income after bills	$368.00	$168.00

A change is made here.

Automatically reflected here (where the data is referenced).

Methods Of Referring To Cells

- Absolute
- Relative

Absolute Reference

- When a reference to an cell or range of cells doesn't change when the contents of a cell or cells is copied or the sheet changes in size.

	A	B	C
1	Net income	$2,000.00	
2			
3		**Feb expenses**	**March expenses**
4	Rent	$907.00	$907.00
5	Parking	$25.00	$25.00
6	Groceries	$300.00	$300.00
7	Car	$500.00	$500.00
8	Fun	$0.00	$100.00
9	Misc	$100.00	$200.00
10	Total expenses	$1,832.00	$2,032.00
11			
12	Income after bills	$168.00	-$32.00

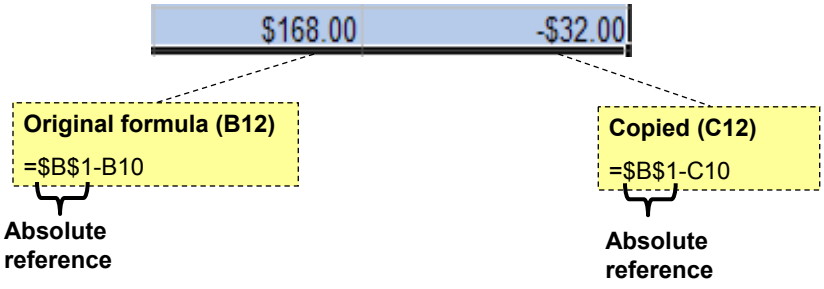
Original formula (B12)

=$B$1-B10

Copied (C12)

=$B$1-C10

Absolute Reference (2)



Absolute reference because the same (absolute) reference to cell B1 is made when the formula is copied.

Absolute Reference (3)

•Typically it's used in conjunction with constants (data that won't change).

	A	B	C
1	Net income	$2,000.00	
2			
3		**Feb expenses**	**March expenses**
4	Rent	$907.00	$907.00
5	Parking	$25.00	$25.00
6	Groceries	$300.00	$300.00
7	Car	$500.00	$500.00
8	Fun	$0.00	$100.00
9	Misc	$100.00	$200.00
10	Total expenses	$1,832.00	$2,032.00
11			
12	Income after bills	$168.00	-$32.00

References to B1 are absolute because income doesn't change

Original formula (B12)

=$B$1-B10

Copied (C12)

=$B$1-C10

Relative Reference

- A reference to a cell or group of cells that may change if the cell/cells are copied or the sheet changes in size.

	A	B	C
1	Net income	$2,000.00	
2			
3		**Feb expenses**	**March expenses**
4	Rent	$907.00	$907.00
5	Parking	$25.00	$25.00
6	Groceries	$300.00	$300.00
7	Car	$500.00	$500.00
8	Fun	$0.00	$100.00
9	Misc	$100.00	$200.00
10	Total expenses	$1,832.00	$2,032.00
11			
12	Income after bills	$168.00	-$32.00

Original formula (B12)

=$B$1-B10

Copied (C12)

=$B$1-C10

Relative Reference (2)

	A	B	C
1	Net income	$2,000.00	
2			
3		**Feb expenses**	**March expenses**
4	Rent	$907.00	$907.00
5	Parking	$25.00	$25.00
6	Groceries	$300.00	$300.00
7	Car	$500.00	$500.00
8	Fun	$0.00	$100.00
9	Misc	$100.00	$200.00
10	Total expenses	$1,832.00	$2,032.00
11			
12	Income after bills	$168.00	-$32.00

Recall:

- Total expenses (row 10) is a calculated value. It sums rows 4 – 9.

Original formula (B12)

=$B$1-B10

Relative reference

Copied (C12)

=$B$1-C10

Relative reference

Relative reference because the copied formula will change relative to how far it's copied.

Relative Reference (3)

- Typically it's used with variable data (that may change over time or over different parts of the sheet).

	A	B	C
1	Net income	$2,000.00	
2			
3		**Feb expenses**	**March expenses**
4	Rent	$907.00	$907.00
5	Parking	$25.00	$25.00
6	Groceries	$300.00	$300.00
7	Car	$500.00	$500.00
8	Fun	$0.00	$100.00
9	Misc	$100.00	$200.00
10	Total expenses	$1,832.00	$2,032.00
11			
12	Income after bills	$168.00	-$32.00

Total expenses may change from month-to-month so references will likely be relative.

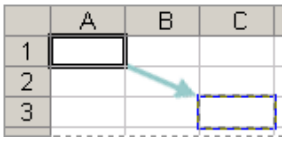
Original formula (B12)

=$B$1-B10

Copied (C12)

=$B$1-C10

Absolute, Relative And Mixed References: Examples[1]



Example	Reference type	Copied result
$A$1	•Absolute column •Absolute row	$A$1
A$1	•Relative column •Absolute row	C$1
$A1	•Absolute column •Relative row	$A3
A1	•Relative column •Relative row	C3

1 Examples from the Excel 2003 Help System

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1. History and purpose of the spreadsheet
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3. **Spreadsheet design**
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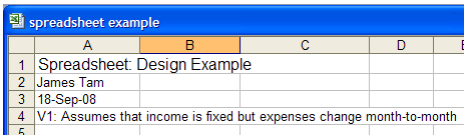
Typical Parts Of A Spreadsheet[1]

- Introduction
- Model and assumptions
- Data Dictionary
- Raw Data
- Calculated Data
- Presentation

1 From the Wiki of Mishtu Banerjee.

Introduction

- A brief summary of the information presented in the spreadsheet
- Title
- List of the author or authors
- Dates of each version (and perhaps a brief description or list of the features of each version).



Model And Assumptions

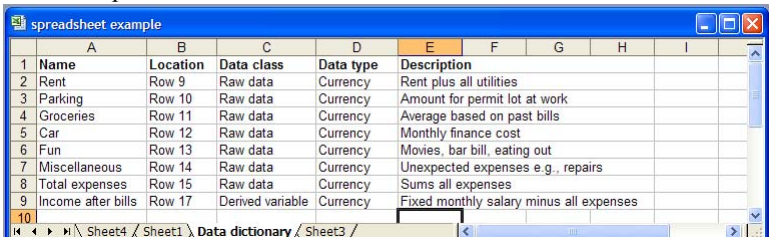
- List and justify and models being used (e.g., mathematical formulas, assumptions based on the work of other people).

Example:

The following spreadsheet determines net income (income after bills) based on the standard accounting formula of subtracting all expenses from all sources of income

Data Dictionary

- Variable: a cell in a spreadsheet that can take on different values.
- For every variable in the spreadsheet note:
  - Location (cell e.g., A3 or range A1:A10)
  - Name of the variable e.g., "Gross income"
  - Data class: raw data, calculated variable, statistical summary
  - Data type e.g., integer, text, currency, date
  - Description: additional details about the type of information that the variable represents



	A	B	C	D	E	F	G	H	I
1	**Name**	**Location**	**Data class**	**Data type**	**Description**				
2	Rent	Row 9	Raw data	Currency	Rent plus all utilities				
3	Parking	Row 10	Raw data	Currency	Amount for permit lot at work				
4	Groceries	Row 11	Raw data	Currency	Average based on past bills				
5	Car	Row 12	Raw data	Currency	Monthly finance cost				
6	Fun	Row 13	Raw data	Currency	Movies, bar bill, eating out				
7	Miscellaneous	Row 14	Raw data	Currency	Unexpected expenses e.g., repairs				
8	Total expenses	Row 15	Raw data	Currency	Sums all expenses				
9	Income after bills	Row 17	Derived variable	Currency	Fixed monthly salary minus all expenses				
10									

Raw Data

- Put it in table form using a standard convention (columns: represent different variables, rows: represent different instances of variables or cases).

Different types of variables

Different instances of clients

Client	Gross income	Investment income
James Tam	$1	$1,000,000
Jamie Smyth	$70,000	$0
Stacey Hearn	$100,000	$1,250

Calculated Data

- Summary statistics: are calculated along a single column and include several rows.
- Derived variables: are calculated along a single row and include several columns.

Summary Statistics

Client	Gross income	Investment income
James Tam	$1	$1,000,000
Jamie Smyth	$70,000	$0
Stacey Hearn	$100,000	$1,250
Averages	**$57,000**	**$333,750**

Derived Variables

Client	Gross income	Investment income
James Tam	$1	$1,000,000
Jamie Smyth	$70,000	$0
Stacey Hearn	$100,000	$1,250

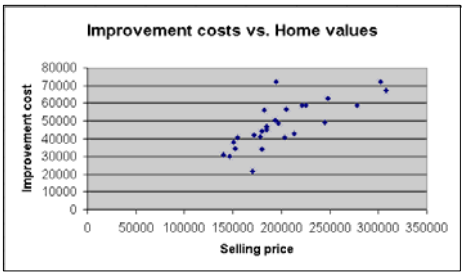
Total income
$1,000,001
$70,000
$101,250

Presentation Of Information

- Highlighting or emphasizing key parts of the data.
- Graphical representations may be appropriate but consider the principles of Information Visualization!

	A	B
1	Market value ($)	Improvement cost ($)
2	140000	31120
3	147000	29900
4	151000	38120
5	152000	34360
6	156000	40710
7	170000	21620
8	172000	42100
9	178000	41070
10	180000	34210
11	180000	44090
12	182000	55960
13	185000	45170
14	185000	46820
15	193400	50200
16	194500	71060
17	197000	48460
18	203000	40720
19	206000	56600
20	213000	42780
21	221000	58770
22	225000	58960
23	245000	48910
24	248000	62620
25	278000	58580
26	302500	72200
27	308000	67320

Data



Presentation of the key parts of the data (one house stands out!)

Spreadsheets: Design Principles

1. For anything but a trivially small sheet try planning it out on graph paper first (what data to include, how will things be laid out etc.)
2. Test your calculations with a reasonable data set.
3. For larger and more complex calculations break results down into intermediate results.
   - Perform the calculation in multiple rather than just a single cell.
4. Make sure that the different parts of a calculation are clear. Avoid "magic numbers" – unlabeled constants.

No ☹

= 2000 – (907 – 25 – 100)

Magic number...avoid doing this!

Yes ☺

Net income	$2,000.00	
	Feb expenses	**March expenses**
Rent	$907.00	$907.00
Parking	$25.00	$25.00
Groceries	$300.00	$300.00
Car	$500.00	$500.00
Fun	$0.00	$100.00
Misc	$100.00	$200.00
Total expenses	$1,832.00	$2,032.00

Net income is explicitly labeled

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Problem Solving Example: Making Change

- Look at this problem before class and try to think of a solution without looking at the answer!
- (Paraphrased from the book "Pascal: An introduction to the Art and Science of Programming" by Walter J. Savitch.

Problem statement:

Create a spreadsheet that will make change. Given an amount of money, the sheet will indicate how many quarters, dimes and pennies are needed.

Making Change: Possible Constants

- Value of a quarter
- Value of a dime

Determining What Information Needs To Be Tracked

1. Amount of change to be returned
2. Number of quarters to be given as change
3. Number of dimes to be given as change
4. Number pennies to be given as change
5. The remaining amount of change still left (changes as quarters, dimes and pennies are given out)

How To Come Up With A Solution

1. If you are truly stuck then STEP AWAY from the computer!
2. Try to picture things in terms of something that you can relate to (i.e., not mathematical formulas) but something in the real world.
   a. Make sure that you understand what the problem truly entails by describing it in terms of what you know e.g., draw pictures, write text descriptions (English), use physical analogies.
   b. Try to work out a solution to the problem in terms of concepts that you are familiar with e.g., draw pictures, write text descriptions (English), use physical analogies.
   c. Then try to translate your solution to a more formalized form (e.g., mathematical formula, computer program).
   d. (If you are having trouble going from (b) to (c)) then try to describe the solution in as much detail as possible using everyday language. If your solution is detailed enough then it's often just a matter of a straight-forward mechanical translation.

Excel Solution

DON'T LOOK at the answer before class.

Change making example	
James Tam	
19-Sep-08	
Constants	
Quarter	25
Dime	10
Change owed	
Value in cents	36
Quarters	
Number quarters	1
Change in quarters	25
Amount left	11
Dimes	
Number dimes	1
Change in dimes	10
Amount left	1
Pennies	
Number pennies	1
Summary	

Design Example

•Constants, using absolute and relative references.

Net income	$2,000.00	
	Feb expenses	**n expenses**
Rent	$907.00	$907.00
Parking	$25.00	$25.00
Groceries	$300.00	$300.00
Car	$500.00	$500.00
Fun	$0.00	$100.00
Misc	$100.00	$200.00
Total expenses	$1,832.00	$2,032.00
Income after bills	$168.00	-$32.00

Testing The Solution

- What should be tested? (What inputs should be used)
  - Running tests with all possible inputs (time-consuming?)
  - Running tests with a subset of the possible inputs (try to catch all reasonable cases)?

- Not testing the programming or performing minimal testing.
  - This may work for small problems
  - With anything but a trivial sized problem finding the errors may be next to impossible unless each portion has undergone a reasonable amount of testing.

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Information Visualization

•(Recall): Finding ways of representing information in a way that amplifies cognition.

	A	B
1	Market value ($)	Improvement cost ($)
2	140000	31120
3	147000	29980
4	151000	38120
5	152000	34360
6	155000	40710
7	170000	21620
8	172000	42100
9	178000	41070
10	180000	34210
11	180000	44090
12	182000	55960
13	185000	45170
14	185000	46820
15	193400	50200
16	194500	71860
17	197000	48460
18	203000	40720
19	205000	56600
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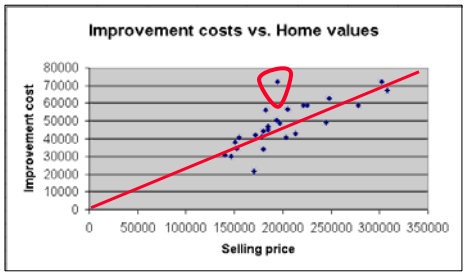


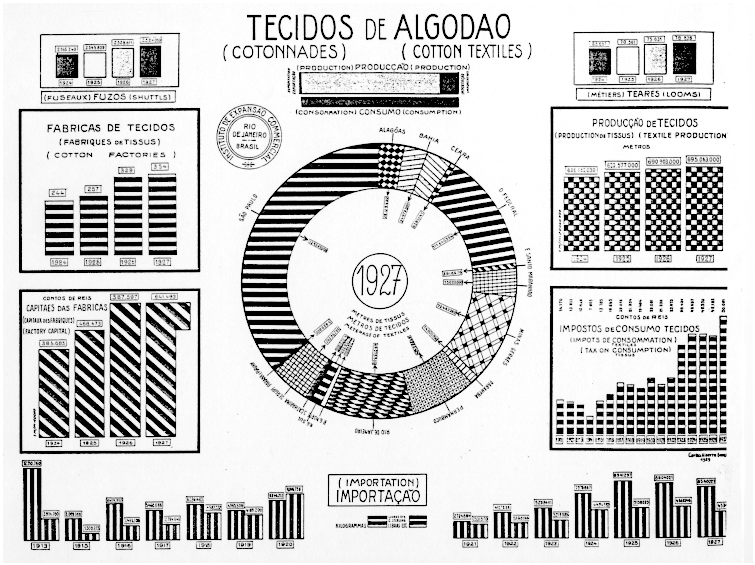
For more information: http://innovis.cpsc.ucalgary.ca/

Some Of Tufte's Principles Of Information Visualization[1]

- The representation should not get in the way of the message
- Avoid distortion
- Provide a broad overview and fine detail

1 "Visual Display of Quantitative Information" by E. Tufte
Note: Some of the visual examples on the following slides are taken from Tufte's books

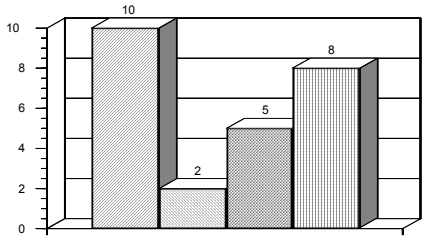
Not Get In The Way Of The Message

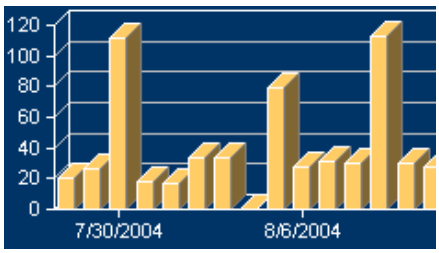


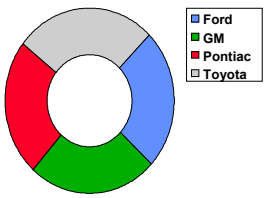
James Tam

Chart Junk: A Common Error (The Representation Getting In The Way Of The Message)

- Information display is not just pretty graphics
  - Graphical re-design by amateurs on computers gives us
    - Overly complicated or even deceptive representations



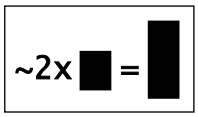




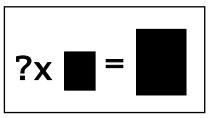
James Tam

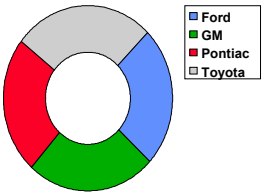
Using Size To Represent Information

- Vary size along one dimension OR the other to represent information but not both.



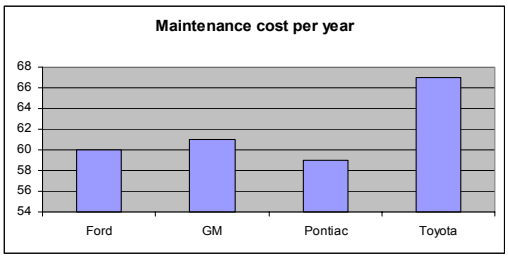
- Increasing along two dimensions at the same time may make the message less clear.

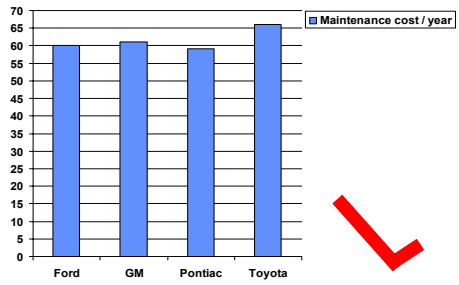




James Tam

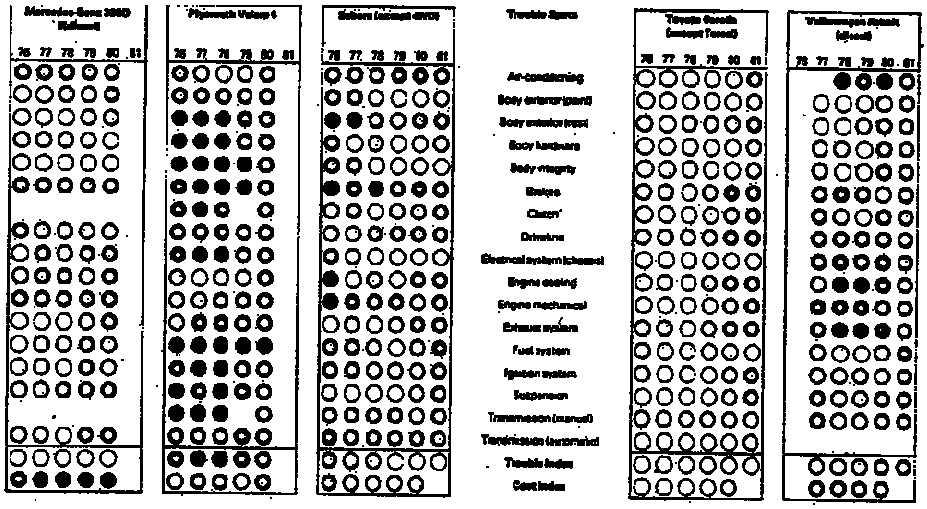
Avoid Distortion: The Representation Alters The Message





James Tam

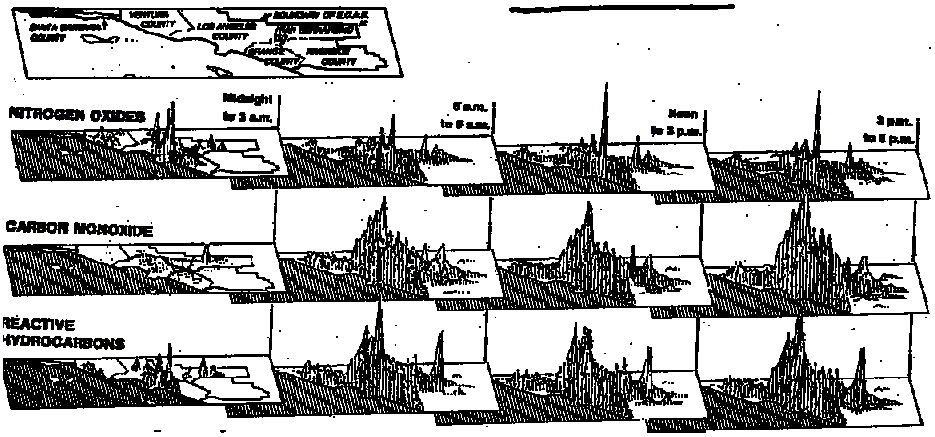
Provide A Broad Overview And Fine Detail



James Tam

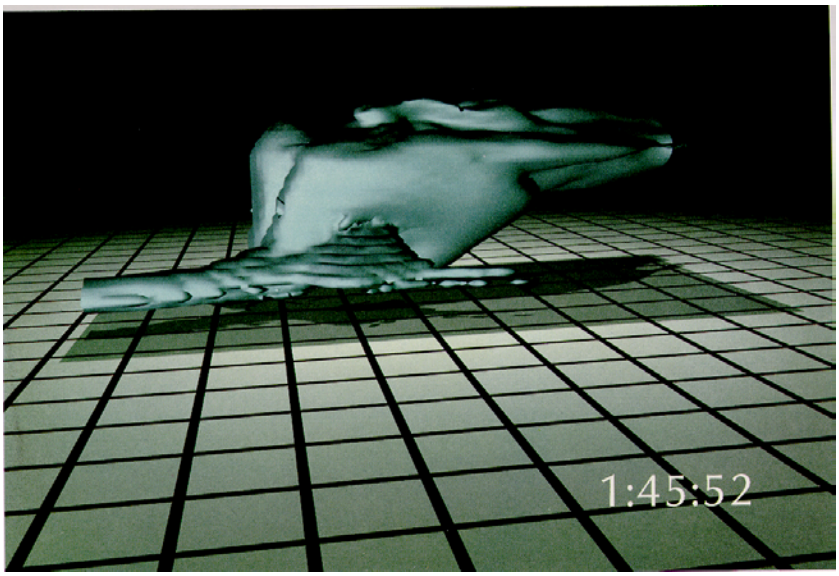
Small Multiples: General Principles

- Learn once
- Invite comparisons



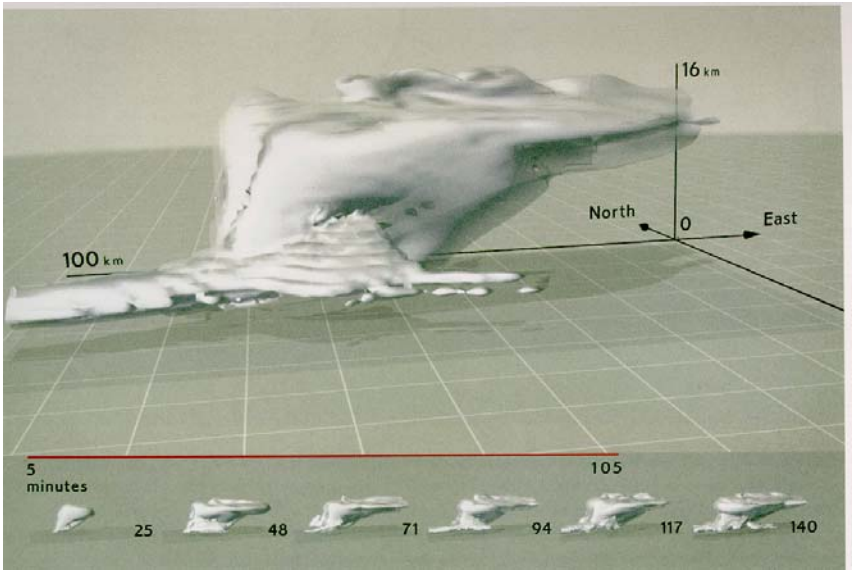
James Tam

Small Multiples: Showing Time And Change



James Tam

Small Multiples: Showing Time And Change



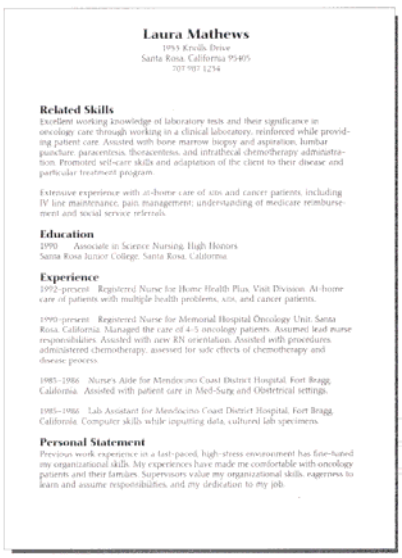
James Tam

CRAP: An Important Tool For Planning Layout And Presentation

- **C**ontrast
  - Make different things appear even more different
  - Brings out dominant elements & mute lesser elements
- **R**epetition
  - Consistency
  - Repeat conventions throughout the interface to tie elements together
- **A**lignment
  - Visually associate related elements by lining them up
- **P**roximity
  - Group related elements
  - Separate unrelated elements

James Tam

Contrasting Contrast



Laura Mathews

1953 Knolls Drive
Santa Rosa, California 95405
707 987 1254

Related Skills

Excellent working knowledge of laboratory tests and their significance in oncology care through working in a clinical laboratory, reinforced while providing patient care. Assisted with bone marrow biopsy and aspiration, lumbar puncture, paracentesis, thoracentesis, and intrathecal chemotherapy administration. Promoted self-care skills and adaptation of the client to their disease and particular treatment program.

Extensive experience with at-home care of sons and cancer patients, including IV line maintenance, pain management; understanding of medicare reimbursement and social service referrals.

Education

1990 Associate in Science Nursing, High Honors
Santa Rosa Junior College, Santa Rosa, California

Experience

1992–present Registered Nurse for Home Health Plus, Visit Division. At-home care of patients with multiple health problems, stis, and cancer patients.

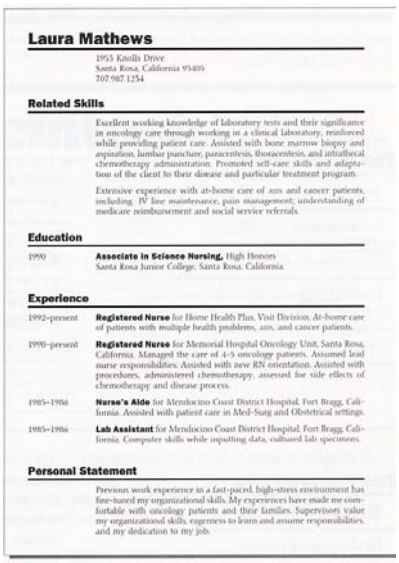
1990–present Registered Nurse for Memorial Hospital Oncology Unit, Santa Rosa, California. Managed the care of 4–5 oncology patients. Assumed lead nurse responsibilities. Assisted with new RN orientation. Assisted with procedures, administered chemotherapy, assessed for side effects of chemotherapy and disease process.

1985–1986 Nurse's Aide for Mendocino Coast District Hospital, Fort Bragg, California. Assisted with patient care in Med-Surg and Obstetrical settings.

1985–1986 Lab Assistant for Mendocino Coast District Hospital, Fort Bragg, California. Computer skills while inputting data, cultured lab specimens.

Personal Statement

Previous work experience in a fast-paced, high-stress environment has fine-tuned my organizational skills. My experiences have made me comfortable with oncology patients and their families. Supervisors value my organizational skills, eagerness to learn and assume responsibilities, and my dedication to my job.



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From "The Non-Designers Design book by Robin Williams

James Tam

Repetition

Mickey Mouse

- Walt Disney Studios
  Anaheim, California
  58 years old, no children

Employment

- Walt Disney Studios
- Various television studios

Education

- Walt Disney Studios

Favorite Activities

- Driving steamboats
- Roping cattle

Favorite Quote

- Everybody can't be a duck.

Repetition in the example

- Font type
- Font size
- Bolded text
- Consistent bulleting

From "The Non-Designers Design book by Robin Williams

James Tam

Alignment

Honor Form

Heresy rheumatic starry offer former's dodder, Violate Huskings, an wart hoppings darn honor form.

Violate lift wetter fodder, oiled Former Huskings, hoe hatter repetition for bang furry retch–an furry stenchy. Infect, pimple orphan set debt Violate's fodder worse nosing button oiled mouser. Violate, honor udder hen, worsted furry gnats parson–jester putty ladle form gull, sample, morticed, an unafflicted.

Tarred gull

Wan moaning Former Huskings nudist haze dodder setting honor cheer, during nosing.

"Violate!" sorted dole former, "Watcher setting darn fur? Denture nor yore canned gat retch setting darn during nosing? Germ pup otter debt cheer!"

"Arm tarred, Fodder." resplendent Violate warily.

"Watcher tarred fur?" aster stenchy former, hoe dint half mush symphony further gull.

Feeder pegs

"Are badger dint doe mush woke disk moaning! Ditcher curry doze buckles fuller slob darn tutor peg-pan an feeder pegs?"

"Yap, Fodder. Are fetter pegs."

"Ditcher mail-car caws an swoop otter caw staple?" "Off curse, Fodder. Are mulct oiler caws an swapped otter staple, fetter checkings, an clammed upper larder inner checking-horse toe gadder

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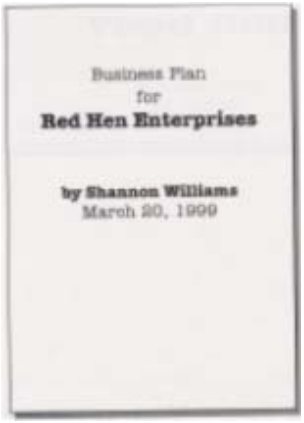
"Ditcher mail-car caws an swoop otter caw staple?" "Off curse, Fodder. Are mulct oiler caws an swapped otter staple, fetter checkings, an clammed upper larder inner checking-horse toe gadder oiler aches, an wen darn tutor vestibule guarding two peck oiler bogs

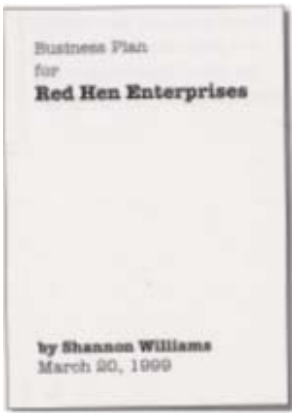
From "The Non-Designers Design book by Robin Williams

James Tam

Legibility And Readability: Center Alignment

- **Some regard it as unprofessional and advocate against it's use.**
- **It's described as being unprofessional looking and plain.**





From the Non-Designer's Design Book page 30

Legibility And Readability: Center Alignment

- **Overuse of centering can make it harder to determine the structure of onscreen elements.**

UNIVERSITY OF CALGARY
DEPARTMENT OF COMPUTER SCIENCE
FACULTY OF SCIENCE
COURSE INFORMATION SHEET
September 10, 2007

1. **Course:** CPSC 203, Introduction to Computers
   Lecture/Time/Session: L02, MW 16:00-17:15, Fall 2007
   Instructor: James Tam, ICT 707, 210-9455
   Office Hours: MW 15:00 - 15:50, T 16:45 - 17:30
   (*If I'm not in my office please check in ICT 102*)
   E-mail: tamj@cpsc.ucalgary.ca
   Website: http://pages.cpsc.ucalgary.ca/~tamj/203

2. **Prerequisites:** None

3. The University policy on grading and related matters is described on pp. 43-45 of the 2007-2008 Calendar. In determining the overall grade in the course, the following weights will be used:
   Assignments 40%
   Midterm Exam 20%
   Final Exam 40%
   The course **will** have a Registrar's scheduled final examination.
   Special regulations affecting the final grade (e.g. requirement to pass the final examination or to pass the laboratory to pass the course): Each of the above components will be given a letter grade using the official University grading system. The final grade will be calculated using the grade point equivalents weighted by the percentages given above and then reconverted to a final letter grade using the official University grade point equivalents.

Legibility And Readability: Center Alignment

•It can be useful for providing additional contrast

- e.g., titles vs. the body of the text.

Some Potential Research Topics

HCI and expert systems: Scope -Masters or Doctorate level projects

There has been little research conducted into determining what is usable for software used by expert users. Most of the work in the area of Human-Computer interaction is more applicable to high level interfaces such as GUI's than they are for low level interfaces such as a Unix command line. Research in this area would involve studying these types of users and their tasks in order to come up with a set of usability heuristics that can guide future designers of these systems as well be used as an evaluation tool for existing systems.

Educational tools: Scope – undergraduate research project

In order to help undergraduate students grasp some of the more difficult and abstract concepts being taught in class, instructors will sometimes provide visual representations in order to provide a mental model of what the code is actually doing. For example, when first teaching linked lists to students it is common to draw out a picture of a list consisting of nodes and their links. List operations are then demonstrated by redrawing some or all parts of the list manually. A useful learning aid could consist of a system that could demonstrate list operations but do so in an interactive fashion. The student could create some code and see the effects of different list operations in order to better understand the cause-effect relationship between the code and the list.

Gaming projects

•So it should be used sparingly

•It should also be used for a reason rather than as the default

Legibility And Readability: Center Alignment

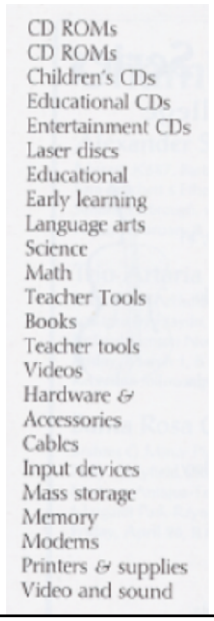
•If you are employing it to provide contrast then at least make it obvious

This text is ***centered.***
If you are going to
center text,
make it obvious.

See, in this paragraph it is
difficult to tell if this text
was centered purposely
or perhaps accidentally.
The line lengths are not
the same, but they are not
really different. If you can't
instantly tell that the type
is centered, why bother?

The Non-Designers Design Book

Proximity


CD ROMs
CD ROMs
Children's CDs
Educational CDs
Entertainment CDs
Laser discs
Educational
Early learning
Language arts
Science
Math
Teacher Tools
Books
Teacher tools
Videos
Hardware &
Accessories
Cables
Input devices
Mass storage
Memory
Modems
Printers & supplies
Video and sound


CD ROMs
CD ROMs
Children's CDs
Educational CDs
Entertainment CDs
Laser discs

Educational
Early learning
Language arts
Science
Math

Teacher Tools
Books
Teacher tools
Videos

Hardware & Accessories
Cables
Input devices
Mass storage
Memory
Modems
Printers & supplies
Video and sound

From "The Non-Designers Design book by Robin Williams

Fonts And Font Effects

- Proper use of typography
  - 1-2 typographical effects (typeface or typography) - 3 max
    - Font types, normal, italics, bold, underline
  - 1-3 fonts sizes max

Large
Medium
Small

Readable

Design components to be inviting and attractive

Design components to be inviting and attractive

✓

Large
Medium
Small

Unreadable

Design components to be *inviting* and attractive

Design components to be **inviting** and ***attractive***

✗

The Gestalt School Of Psychology

•Founded in 1912 to investigate how do people organize the world into meaningful units and patterns.




James Tam

What Is A Gestalt?

•Gestalt: is German for 'pattern' or 'configuration'.

•Motto of the Gestalt psychologists:

- "The whole is more than the sum of it's parts' e.g., an image is not just an unrelated bunch of dots.
- What you perceive is greater than what you see.
- Example one: Motion is perceived from a series of still images

James Tam

What Is A Gestalt? (2)

- Example two: the following is more than just a series of splotches of light and dark (a pattern can be perceived).

James Tam

The Gestalt Laws

- They are rules that describe the way that people see patterns in visual displays:
  1. Proximity
  2. Similarity
  3. Continuity
  4. Symmetry
  5. Closure
  6. Relative size
  7. Figure and ground

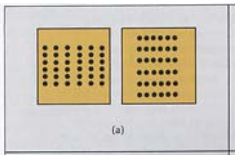
James Tam

Proximity

•Things that are near to each other tend to be grouped together.

- Example one:

- Example two:



Proximity (2)

•Things that are close together imply a relationship (they get grouped together).

Group	**Constants**	
	Quarter	25
	Dime	10
Group	**Change owed**	
	Value in cents	36
Group	**Quarters**	
	Number quarters	1
	Change in quarters	25
	Amount left	11
Group	**Dimes**	
	Number dimes	1
	Change in dimes	10
	Amount left	1

Proximity (3)

•Proximity appears to form two groups which may present a confusing message.

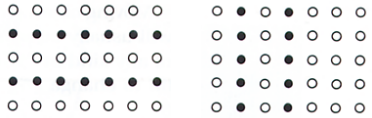
Proximity (4)

•In this example the proximity of different controls is misleading.

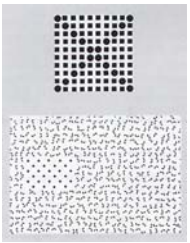
Similarity

- Things that are alike tend to perceived as belonging together.
- Similarity can be perceived in many ways:
  - Color
  - Shape
  - Size
  - Etc.

Example one:

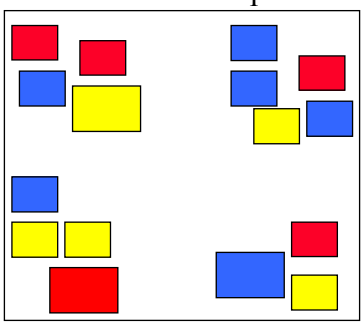


Example two:



Similarity

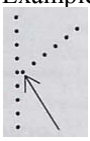
•Using different representations to show similarity can communicate multiple relationships.



Continuity

•Lines and patterns tend to be perceived as continuing in time and space.

- Example one:

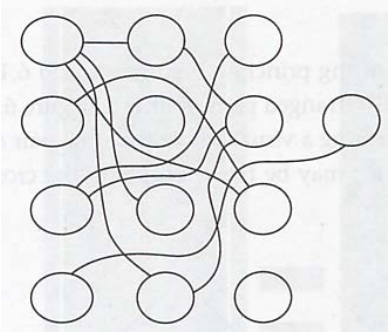


- Example two:

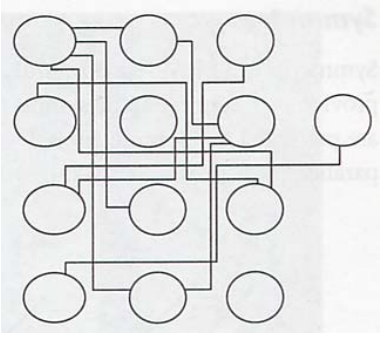
Continuity (2)

•Visual entities (groupings) are more likely to be perceived out of visual elements that are smooth rather than elements with abrupt changes in direction.

Smooth connections



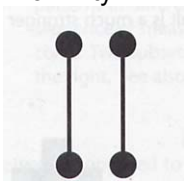
Abrupt connections



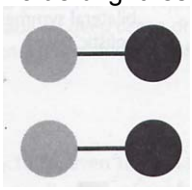
Continuity (3)

•Connectedness is a stronger grouping principle than:

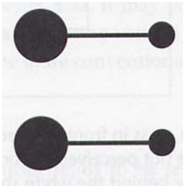
Proximity



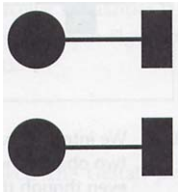
Value/brightness



Size



Shape

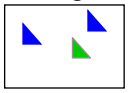


Using Color

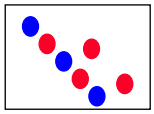
•Color is one of the most widely used (and misused) way of communicating information.

•Color works well for:

- Making things stand out



- Grouping related items

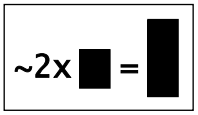


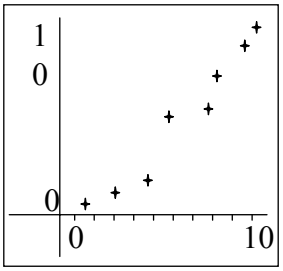
Using Color (2)

•Color should not be used for:

- Communicating numerical information

- (In these cases): Consider using something else like size or position.



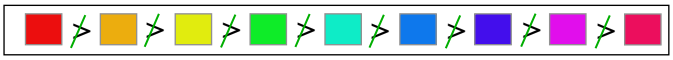


James Tam

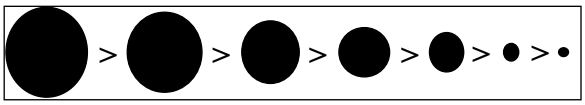
Using Color (3)

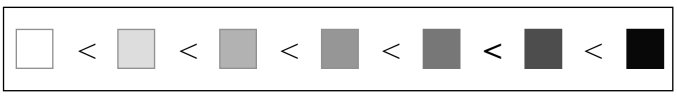
•Color should not be used for:

- Showing a ranking between items



- (In these cases): Consider using something else like size, position or brightness/value.



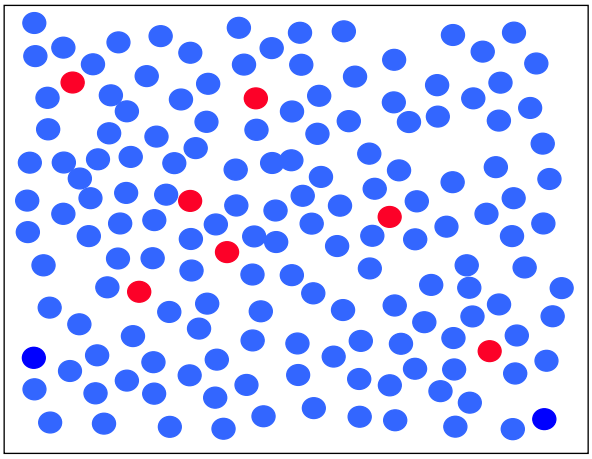


James Tam

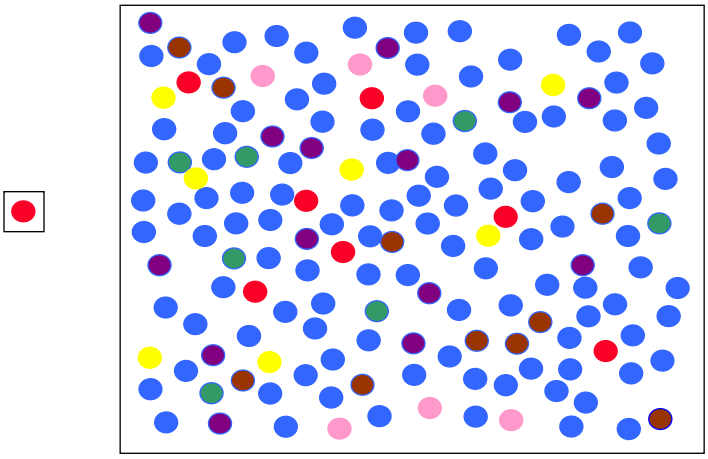
Use Color Sparingly

•Don't use color like did when you were a kid.

Color Is Used Sparingly: Effective

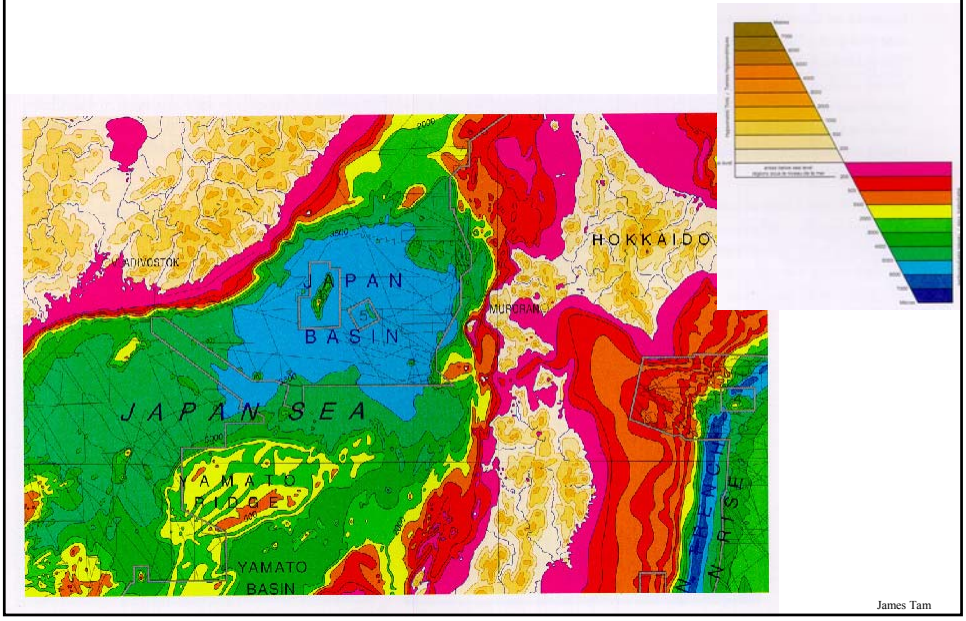


The Increased Use Of Color: Mutes The Message



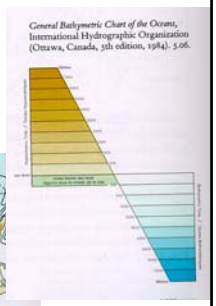
James Tam

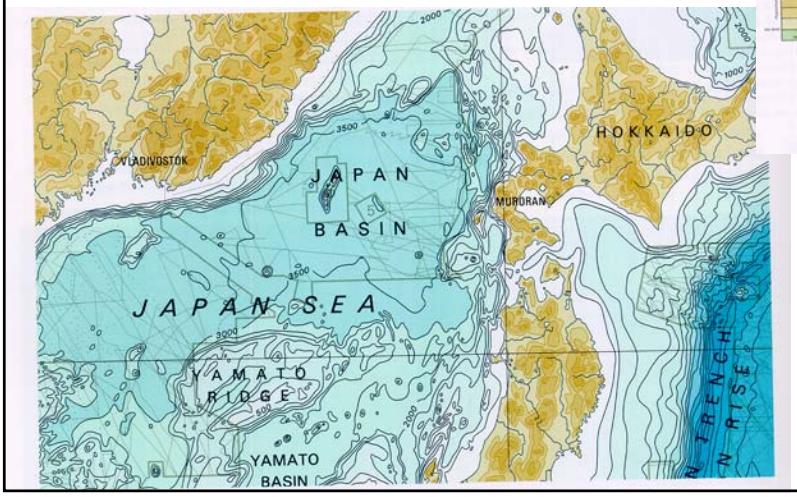
Over Use Of Color: Mutes The Message



James Tam

Color Is Used Sparingly: Effective





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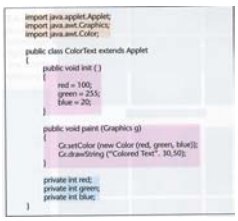
Additional Issues Associated With Color

- Color blindness:
  - The majority of people who are color blind are red-green color blind so these colors should be avoided when communicating information.
- Field size
  - The larger the area to be color coded, the more easily that colors can be distinguished.



```
import java.applet.Applet;
import java.awt.Graphics;
import java.awt.Color;

public class ColorText extends Applet
{
    public void init ( )
    {
        red = 100;
        green = 255;
        blue = 20;
    }

    public void paint (Graphics g)
    {
        G.setColor (new Color (red, green, blue));
        G.drawString ("Colored Text", 30,50);
    }

    private int red;
    private int green;
    private int blue;
}
```

James Tam

Additional Issues Associated With Color (2)

•Field size

- When objects are small (text or small images) and color is used to distinguish information use highly saturated colors.

This is important information!

This is important information!

•Conventions

- "Commonly accepted" conventions can vary widely by culture and their use should be carefully considered e.g., white is associated with purity in some Western cultures and death with some Eastern cultures.

Color And Cultural Associations

	Egypt	China	Japan	India	France
Red	• **Death**	•**Happiness**	• **Anger, Danger**	• **Life, creativity**	• **Aristocracy, Freedom, Peace**
Blue	• **Virtue, Faith, Truth**	• **Heavens, Clouds**	•**Villainy**		• **Freedom, peace**
Green	• **Fertility, Strength**	• **Ming Dynasty, Heavens, Clouds**	• **Future, Youth, Energy**	• **Prosperity, Fertility**	•**Criminality**
Yellow	• **Happiness, Prosperity**	• **Birth, Wealth, Power**	• **Grace, Nobility**	•**Success**	•**Temporary**
White	•**Joy**	•**Death, Purity**	•**Death**	• **Death, Purity**	•**Neutrality**

From "How Fluent is Your Interface? Designing for International Users" Proceedings of the INTERCHI'93. Russo P. and Boor S.

Image-Based Object-Recognition

- People have a powerful ability to recognize images that they have previously seen.
  - e.g., Standing et. al. (1970)[1] had over a 90% accuracy rate with test subjects recognizing whether or not they had previously seen an image (out of 2560 viewed over several days)

1 Standing, L., Conezio, I., and Haber, R.N. (1970) Perception and memory for pictures: single trial learning of 2560 visual stimuli. Psychonomic Science 19: 73 – 74).

James Tam

Images Vs. Words

- Static images vs. words
- Animated images vs. words

James Tam

Static Images Vs. Words

•Pictures are better than text for showing structural relations.

Text

Jane is Jim's boss.

Jim is Joe's boss.

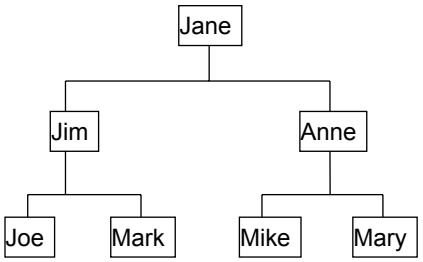
Anne works for Jane.

Mark works for Jim

Anne is Mary's boss.

Anne is Mike's boss.

Structure diagram



Static Images Vs. Words (2)

•Generally images should when:

- Structural information must be shown (links between entities or groups of entities).
- A great deal of information needs to be remembered (images are more easily recalled than text except for abstract images e.g., when the concept being represented is new and must be represented abstractly by an image and out of context).

•Generally text or the spoken language should be used when:

- Abstract concepts must be portrayed e.g., freedom, efficiency.
- The information is complex, procedural or non-spatial.

Animated Images Vs. Words

- Generally animated images should be used when:
  - A cause-effect relation must be expressed
  - When a structure is being transformed (e.g., the motion of a hinge) – but complex interactions may not be interpreted correctly.
  - A sequence of data movements (e.g., sports, martial arts)

- Generally text or the spoken language should be used when:
  - In general everyday language (e.g., English, Chinese, Spanish, Russian etc.) is so widespread, elaborate and complete that written or spoken language should be used unless there is a compelling reason (above and previous) to do otherwise.

You Should Now Know

- What is the purpose of a spreadsheet
- What are the advantages of using an electronic spreadsheet over a paper version
- The difference between an absolute and relative reference
- What are the typical parts of a spreadsheet
- Some spreadsheet design principles
- How to go about solving simple problems using a spreadsheet
- Why is testing important and how to determine a reasonable range of test cases
- Three of Tufte's principles of Information Visualization

You Should Now Know (2)

- How the principle of Small Multiples can be used to make it easier to interpret and understand data
- How the principles of CRAP can be applied in the design of documents such as spreadsheets
- What are the Gestalt Laws and how they can be used for more effective representations